2002 SALMON SPAWNING GROUND SURVEYS IN SELECTED TRIBUTARIES OF THE CEDAR RIVER, WASHINGTON

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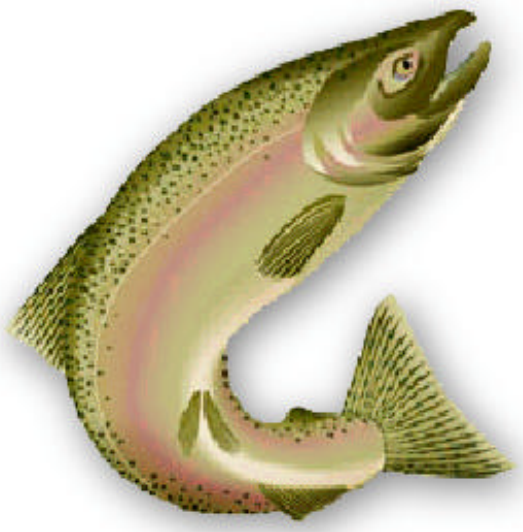

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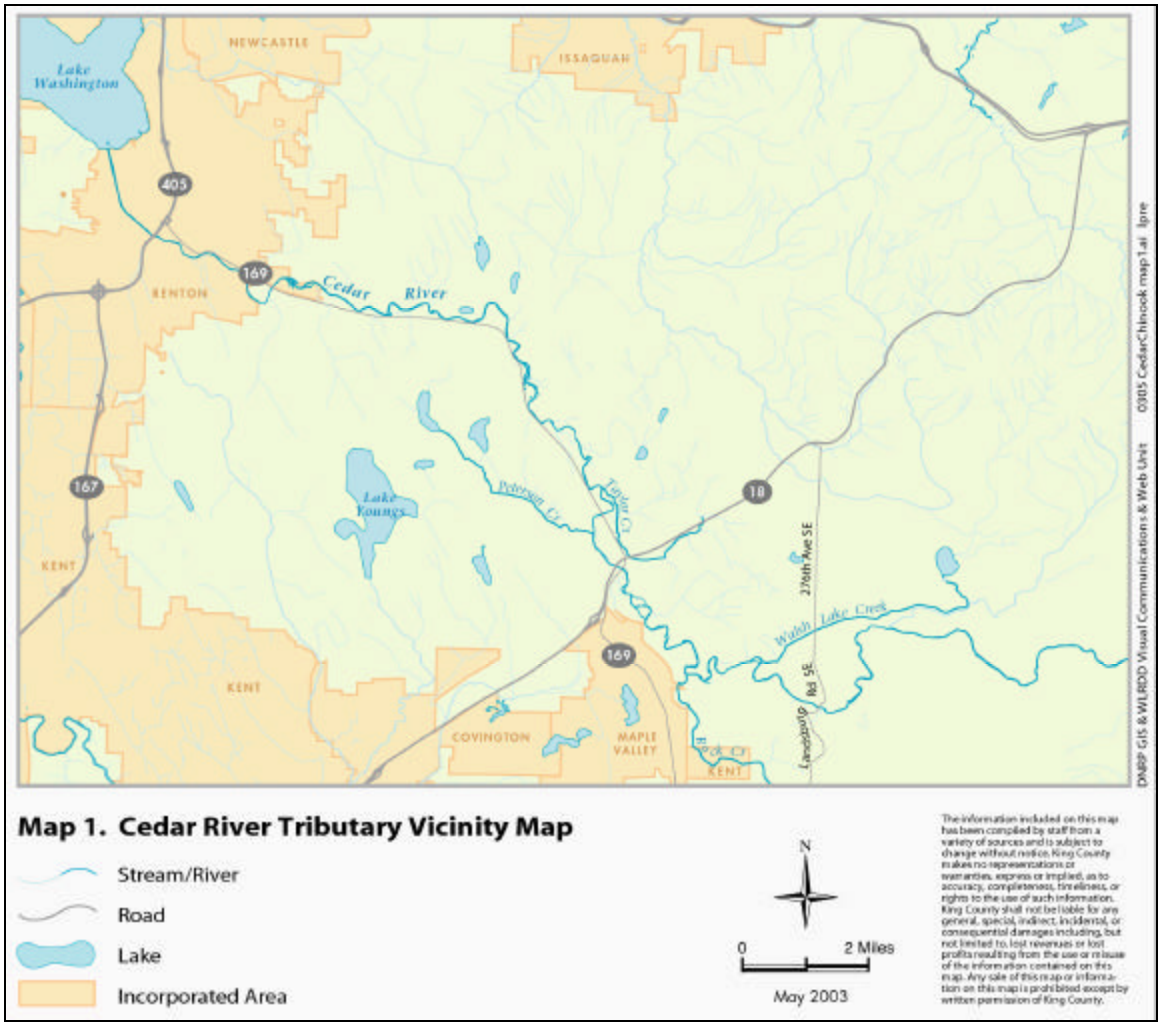
INTRODUCTION

Foot surveys were conducted for the presence of adult chinook salmon (*Oncorhynchus tshawytscha*) in the four largest tributaries of the Cedar River below Landsburg during the fall of 2002. These surveys were a cooperative effort between Washington State Department of Fish and Wildlife (WDFW) and King County Water and Land Resources Division (WLRD). Tributaries surveyed in this effort include Rock and Taylor Creeks (surveyed by WDFW) along with Peterson and Walsh Lake Creeks (surveyed by WLRD). Surveys began during the first week of October and continued through the middle of December. Survey reach lengths varied in each stream depending on access to available spawning habitat for chinook salmon. All survey reaches began at or near the confluence with the Cedar River (Map 1). These reaches were selected based on their likelihood of containing suitable chinook spawning habitat, and/or the observation of adult chinook in recent years (Priest and Berge 2002).

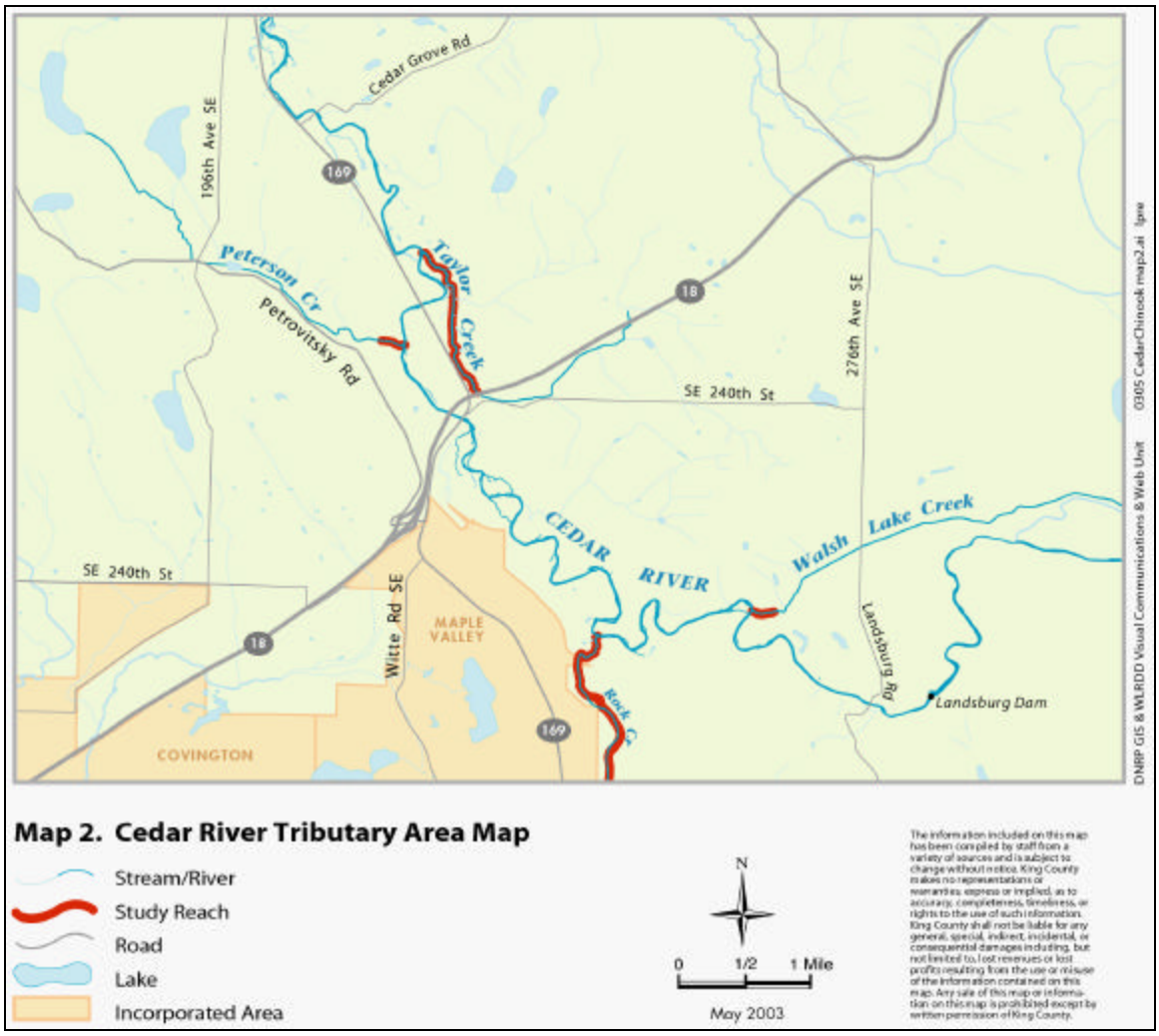
Map 1. Cedar River Tributary Vicinity Map



STREAM DESCRIPTIONS

The Cedar River drains a watershed of 188 square miles and is approximately 56 miles in length (King County 1993). Currently, anadromous fish have access to spawning habitat in the mainstem river up to the Landsburg dam located at River Mile (RM) 21.8. The four tributaries surveyed (Taylor, Peterson, Rock, and Walsh Lake) are all located between RM 13.1 and 19.8 (see Map 2). These streams range in length from 1.6 to 7.0 miles and have catchment areas ranging from 5.2 to 12 square miles (King County 1993).

Map 2. Cedar River Tributary Area Map



Taylor Creek enters the river-right bank of the Cedar River at RM 13.1 (Map 2). It is approximately 3.3 miles long with a catchment area of 5.2 square miles (King County 1993). Surveys began at the mouth and proceeded upstream to the Highway 18 crossing, approximately 1.2 miles upstream. The lower section is channelized into a roadside ditch with a mix of riffles, runs, and low quality pools (as defined by Platts et al.1983). The riparian zone in this survey reach is fragmented into a mix of deciduous trees, shrubs (both native and invasive), landscaped lots, and active cattle pastures. The upper segment surveyed in Taylor Creek is within a King

County restoration project located approximately one mile upstream of the mouth. Large woody debris (LWD) has been placed in the restoration area but is not found in the two lower segments (King County 2000). Channel configuration, depth, and stream flow in Taylor Creek allows early season access for spawning salmon, including chinook, sockeye (*O. nerka*), and coho (*O kisutch*). The dominant substrate consists of sand and gravel, making this stream particularly susceptible to movement and scour during storm events. Taylor Creek is prone to annual flooding in this reach due to a combination of a narrow channel and flat valley floor topography. During rain events the clarity of Taylor Creek can rapidly turn from clear to "mud" brown and is subjected to runoff flooding along the Maxwell Road (King County 1993). Flows in Taylor Creek during chinook surveys range from a low of two cubic feet per second (cfs) to a high of more than 20 cfs (Figure 1).

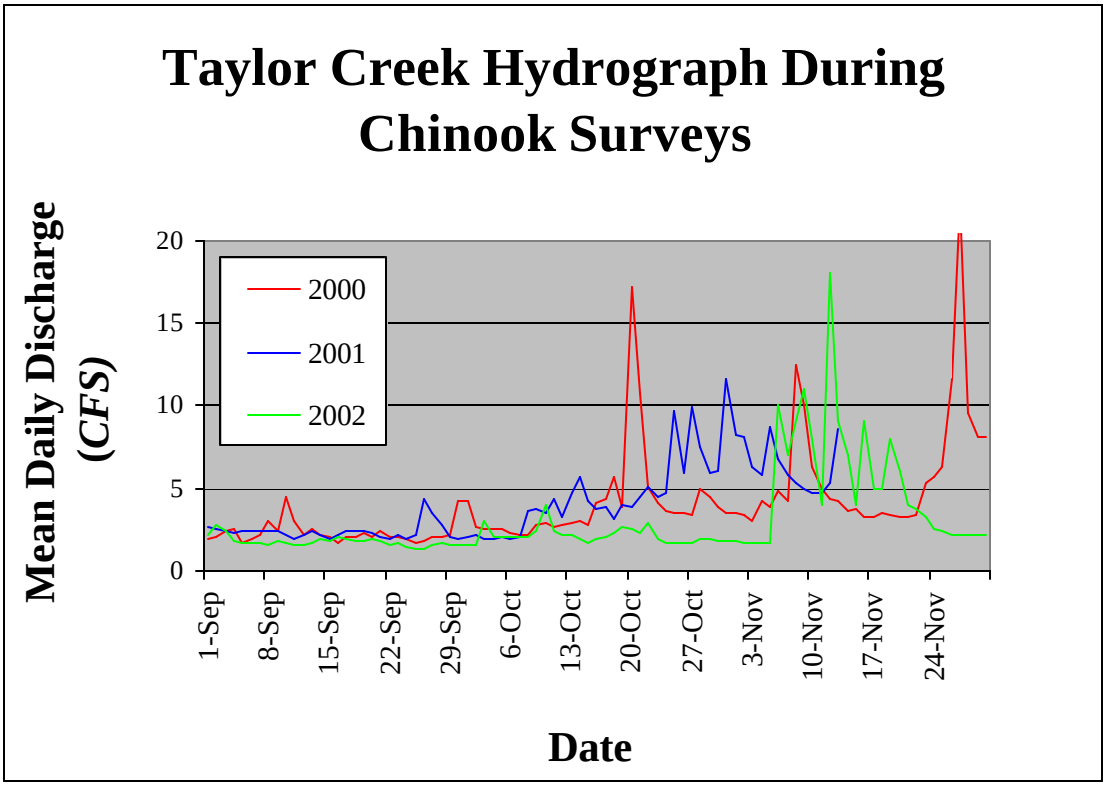


Figure 1. Taylor Creek Hydrograph

Peterson Creek enters the river-left bank of the Cedar River at RM 14.1 (Map 1). It is approximately 1.6 miles long with a catchment area of 6.3 square miles (King County 1993). Chinook surveys began at the confluence of Peterson Creek with the Cedar River to 1000 feet upstream. This reach has a mix of habitat types including riffles, runs, and a variety of pool types (as defined by Platts et al., 1983). An accumulations of LWD in the channel adds to a relatively stable channel, with patches of suitable spawning gravels for salmonids. The riparian zone of Peterson Creek consists of a mixed coniferous and deciduous forest that covers steep ravine walls until the channel enters the Cedar River. The substrate in this channel ranges from fine sediments to large cobbles and small boulders. In some sections of the survey reach the substrate is underlain by cemented glacial till. Flows are relatively stable throughout the year due to a low density of development in this tributary basin, although a combination of low flows in Peterson Creek and the Cedar River mainstem during the early fall limits access of adult salmonids to this stream. Typical flows in Peterson Creek during chinook surveys are around three cfs (Figure 2).

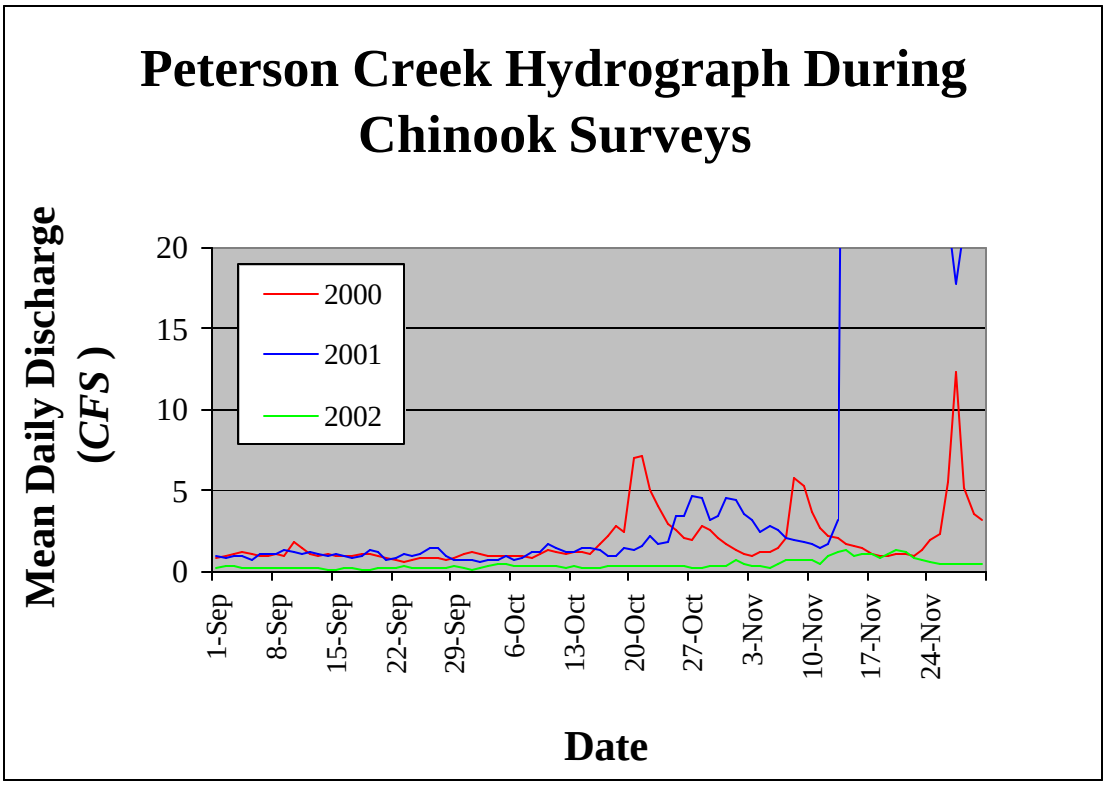


Figure 2. Peterson Creek Hydrograph

Rock Creek enters the river-left bank of the Cedar River at RM 18.2 (Map 1). It is approximately seven miles long with a catchment area of 12 square miles (King County 1993). Currently, anadromous fish have access from the mouth to RM 2.65 (King County 1993). The survey began at the confluence with the Cedar River and ended at the Summit-Landsburg Road approximately 1.4 miles upstream of the mouth. This stream survey is broken into three reaches. Reach one begins at the confluence with the Cedar River and ends at the Seattle Water Department (SWD) pipeline approximately 0.2 miles upstream. A mix of riffles, runs, and pools characterizes the habitat in this reach with substrates ranging from fine gravel to small boulders (as defined by Overton et al., 1997). The riparian cover is a mix of maturing deciduous and coniferous forest in this reach. There are three houses adjacent to Rock Creek along the right bank in the lowest 500 feet of channel that creates a fragmented riparian zone. Large woody debris is abundant in the channel above the SE 248th Street crossing, but it is absent in the channel downstream to the confluence with the Cedar River. Reach two begins at the upstream end of the SWD pipeline and continues upstream for approximately 0.7 miles. Reach 3 continues upstream to the Summit-Landsburg road and is characterized by a gradient break, that changes geomorphic characteristics of the channel of Rock Creek. Reach one has a steeper gradient (3.6%) than reach two (approximately 1-2%) and reach three (approximately .6%). The habitat in Reach 2 includes a variety of spawning and rearing habitat, whereas Reach 3 contains much larger pools with very little riffle sections in between. The dominant substrate in Reach 2 is gravel and cobble. In contrast, the dominant substrate type in Reach 3 is fine organic material, due to the lower gradient and formation of large pool complexes. In Reach 2, LWD is found throughout the stream corridor, and in Reach 3 LWD is much more dense, resulting in the formation of complex log jams, which in-turn retain sediment in this reach. There is maturing riparian zone in reach two, consisting of both mature deciduous and coniferous trees. The flow pattern in Rock Creek is very stable, as a result of the underlying geology. Rock Creek is made

up of a glacial alluvial outwash plain that maintains a consistent flow regime from year to year. This protection results in excellent water quality and clarity in the stream, with very few incidences of turbidity except during storm events. Flows in Rock Creek during chinook surveys average around five cfs, with slight variation between years for the years 1998 through 2002 are represented by the following hydrograph (Figure 3).

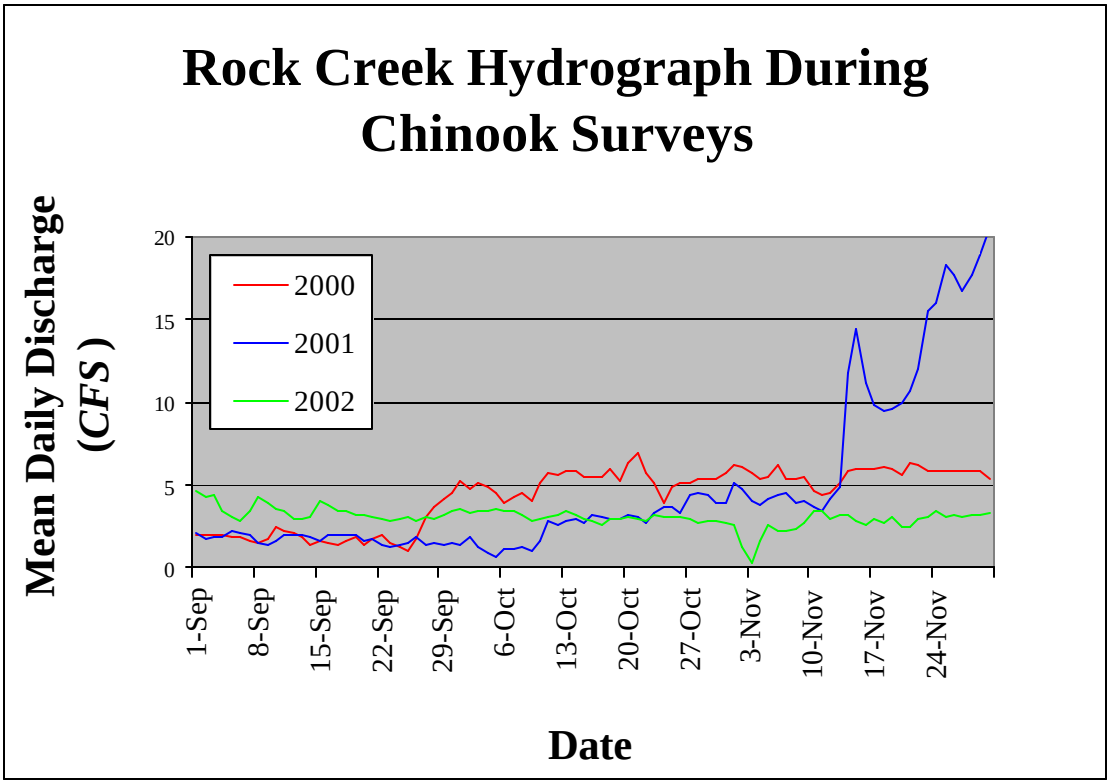


Figure 3. Rock Creek Hydrograph

Walsh Lake Creek (also known as Walsh Lake Diversion Ditch) enters the river-right bank of the Cedar River at RM 19.8 (Map 1). It is an artificially constructed channel that was built in 1931 by the SWD (now Seattle Public Utilities) to help maintain water quality in the municipal watershed. It is approximately 3.5 miles long with a catchment area of 6.6 square miles (King County 1993). The survey was conducted from the confluence into a ravine approximately 1000 feet upstream from the Cedar River. A maturing deciduous forest, with scattered conifers dominates the riparian zone along this reach of Walsh Lake Creek. The active channel lacks naturally placed LWD within this reach. In 1995, there was a King County LWD placement project that has helped stabilize the channel by storing sediment and created additional spawning habitat for salmonids. During storm events this channel is very dynamic in both flow response and sediment transport that can reduce water clarity. Sediment size ranges from sand and gravel up to small boulders. There are many habitat types in this stream including low- and high-gradient riffles along with a variety of pool types as defined by Platts et al., (1983). Flow data is not available for this stream, but 2002 flows were similar to other tributaries surveyed.

METHODS

Surveys were conducted on foot, with surveyors wearing hip waders and polarized glasses while traveling in an upstream direction. Surveys were conducted once a week during the spawning season. In addition, WDFW staff conducted otolith recovery studies for adult sockeye and provided data according to the described protocols. Data was also collected on the sex, age, length, and evidence of an adipose fin clip. Each chinook carcass was scanned for the presence of a coded wire tag. Adult salmonids, both live and dead, were counted and recorded in a write-in-the-rain field book. Redds were enumerated only when live chinook were observed exhibiting spawning behavior as described by Mavros et al., 2000. Surveys were not conducted when storm related turbidity prevented accurate assessment of salmonid species present in the survey reach.

OBSERVATIONS

Taylor Creek: Adult chinook and sockeye were first seen in the survey reach on October 2. The peak live count for chinook was 11 fish on October 14, with a total of 26 adults counted for the season. Sockeye totals steadily rose from 1 live fish counted on October 2, and 370 fish counted on the final survey date, November 14. No live coho or carcasses were found in this stream during the 2002 surveys.

Table 1. Taylor Creek 2001 chinook spawner survey data

Date	Live Chinook	Chinook Carcass	Chinook Redds	Live Sockeye	Sockeye Carcass	Live Coho	Coho Carcass
9/16/02	0	0	0	0	0	0	0
9/27/02	0	0	0	0	0	0	0
10/2/02	3	1	2	1	1	0	0
10/10/02	2	4	1	3	5	0	0
10/14/02	11	3	6	3	2	0	0
10/21/02	9	4	2	25	13	0	0
10/28/02	3	4	1	49	14	0	0
11/5/02	0	3	0	76	32	0	0
11/14/02	0	1	0	370	47	0	0

Taylor Creek Chinook Carcass Data: Carcasses collected in 2002 provided some unique insight into population characteristics of spawning chinook in Taylor Creek. Four of the seventeen carcasses collected in 2002 had adipose fin clips, indicating they are of hatchery origin. None of the carcasses collected in Taylor Creek had coded wire tags, suggesting their origin is likely the Issaquah Creek Hatchery. The age of maturity varied between three (41%) and four (59%) year old chinook. The sex ratio of the 17 carcasses was approximately 53% males and 47% females. Fork lengths varied between three- and four-year-old chinook (Figure 4), with three-year-olds having a fork length of 72.8 cm (SD 6.4) and four-year-olds having a mean fork length of 81.7 cm (SD 7.3).

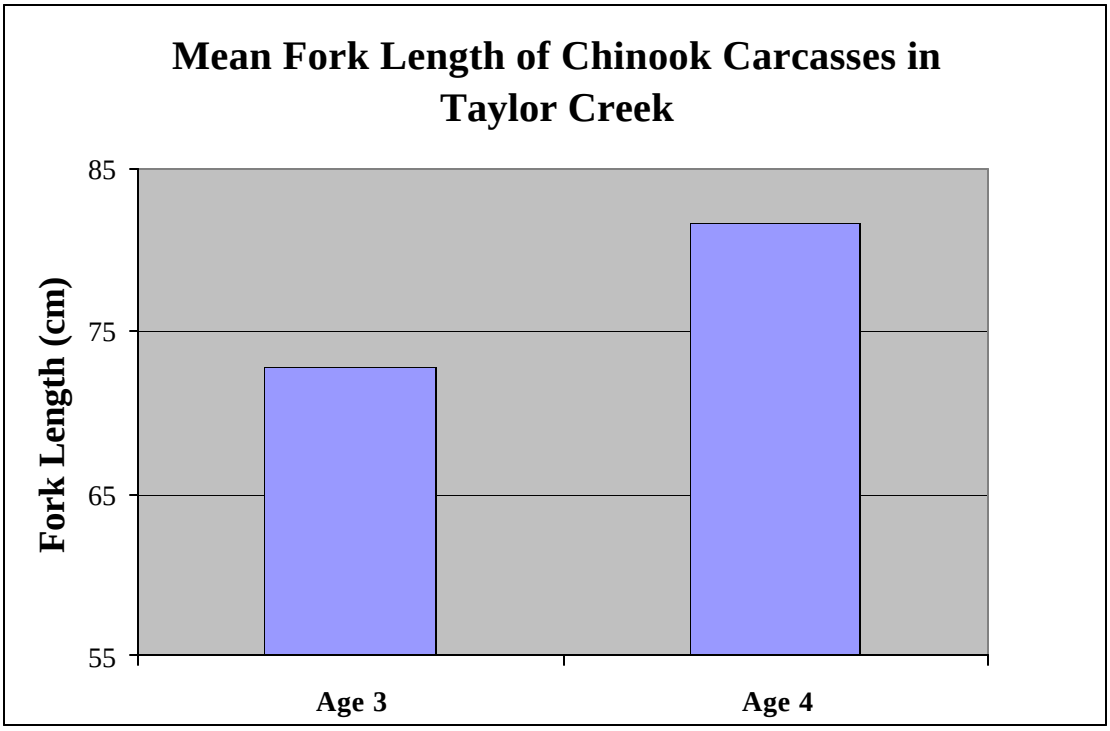


Figure 4. Fork lengths (cm) of chinook carcasses collected in Taylor Creek

Peterson Creek: During these surveys, no live salmonids were observed in Peterson Creek. One sockeye carcass was observed in Peterson Creek on November 20. Due to low stream flow across a river gravel bar in 2002, access was limited for adult spawners in this channel throughout most of the surveys. The final survey date for Peterson Creek was on December 17.

Table 2. Peterson Creek 2002 chinook spawner survey data

Date	Live Chinook	Chinook Carcass	Chinook Redds	Live Sockeye	Sockeye Carcass	Live Coho	Coho Carcass
10/8/02	0	0	0	0	0	0	0
10/15/02	0	0	0	0	0	0	0
10/22/02	0	0	0	0	0	0	0
10/30/02	0	0	0	0	0	0	0
11/5/02	0	0	0	0	0	0	0
11/12/02	0	0	0	0	0	0	0
11/20/02	0	0	0	0	1	0	0
11/26/02	0	0	0	0	0	0	0
12/03/02	0	0	0	0	0	0	0
12/11/02	0	0	0	0	0	0	0
12/17/02	0	0	0	0	0	0	0

Rock Creek: Sockeye were observed in Rock Creek earlier in the season and in greater numbers than in recent years (King County 2000b). Sockeye were first seen on September 23, with 9 live sockeye counted. Sockeye numbers rose sharply the following week with 305 live sockeye, and a peak live count of 596 fish and 152 carcasses. The last live sockeye was a single fish counted on January 31, 2003. Only one chinook was observed in Rock Creek on November 7 during the 2002 spawner surveys. Live coho were first seen on January 2, 2003, with a total of 53 fish and 12 carcasses counted. This was also the peak live count for coho during the surveys. The last live coho for the season was seen on February 6.

Table 3. Rock Creek 2001 chinook spawner survey data

Date	Live Chinook	Chinook Carcass	Live Sockeye	Sockeye Carcass	Live Coho	Coho Carcass
9/3/02	0	0	0	0	0	0
9/23/02	0	0	9	4	0	0
10/3/02	0	0	305	22	0	0
10/10/02	0	0	389	254	0	0
10/16/02	0	0	333	165	0	0
10/24/02	0	0	413	204	0	0
11/1/02	0	0	299	233	0	0
11/7/02	1	0	351	149	0	1
11/14/02	0	0	596	152	0	0
11/22/02	0	0	332	310	0	0
11/27/02	0	0	210	145	0	0
12/5/02	0	0	238	114	0	0
12/16/02	0	0	352	80	0	0
12/20/02	0	0	198	48	0	0
1/2/03	0	0	141	67	53	12
1/9/03	0	0	31	65	10	15
1/17/03	0	0	11	19	4	6
1/24/03	0	0	1	7	13	6
1/31/03	0	0	1	1	4	7
2/6/03	0	0	0	1	1	1
2/13/03	0	0	0	0	0	0
2/27/03	0	0	0	1	0	0

Walsh Lake Creek: No chinook were observed during the 2002 surveys for this stream. A combination of a dry spring and summer along with a lack of fall precipitation prevented access to this channel for retuning adult salmon. Access to this stream over the past several years has typically been later than the other surveyed tributaries due to an alluvial sediment wedge that forms annually at the confluence with the Cedar River. The first sockeye was observed on November 11 following the first significant precipitation in several months. There was a rapid peak and decline in sockeye totals that was a result of stream access due to a decrease in

precipitation and stream flow. On the final survey date, sockeye numbers increased as rainfall and stream flow increased. Live coho were seen twice during the 2002 surveys when access to the channel was available. They were seen on November 11 and December 17.

Table 4. Walsh Lake Diversion Ditch 2001 chinook spawner survey data

Date	Live Chinook	Chinook Carcass	Chinook Redds	Live Sockeye	Sockeye Carcass	Live Coho	Coho Carcass
10/8/02	0	0	0	0	0	0	0
10/15/02	0	0	0	0	0	0	0
10/22/02	0	0	0	0	0	0	0
10/30/02	0	0	0	0	0	0	0
11/5/02	0	0	0	0	0	0	0
11/12/02	0	0	0	1	0	0	0
11/20/02	0	0	0	44	3	6	0
11/26/02	0	0	0	14	15	0	1
12/3/02	0	0	0	1	13	0	0
12/11/02	0	0	0	1	12	0	0
12/17/02	0	0	0	13	12	11	1

DISCUSSION

Total chinook salmon escapement in the Cedar River Basin for 2002 was estimated to be 369 fish. Access to tributary spawning habitat for chinook salmon was limited during these surveys because of unusually late fall rains resulting in low instream flows. This was the case for Peterson and Walsh Lake Creeks. Walsh Lake Creek has an annual accumulation of a sediment alluvial wedge at the confluence with the Cedar River. In 2002, there was a smaller alluvial deposit from previous years resulting in easier early season access for returning chinook. Due to a mild winter and a very dry summer and fall, low Cedar River flows continued to restrict access for adult salmon until early November. Peterson Creek has virtually no access for adult salmon in the early fall because of a mainstem gravel bar deposit that has formed at the confluence with the Cedar River.

The two streams that chinook were able to access, Taylor and Rock creek, fish totals, run timing and distribution were considerably different. The run timing for sockeye was considerably different for 2002 for the two streams. Taylor Creek had low numbers of returning sockeye during October while Rock Creek continued to have an increase in large numbers of spawning sockeye. Competition for available spawning habitat during October may be one factor determining the presence or absence of spawning chinook. Another factor may be the type of habitat chinook prefer for spawning. Although both streams are accessible to chinook, the increased gradient in Rock Creek between the 248th Street crossing and the Seattle Water Pipeline may discourage upstream travel for more desirable spawning locations in the mainstem Cedar River. In contrast, lower Taylor Creek has a more desirable gradient for chinook spawning, which is consistent with the observations contained in this report.

Tributaries play an important part of chinook survival in the Cedar River watershed. They provide additional spawning habitat and contribute genetic diversity to the population. Nearly 6% of the Cedar River Watershed chinook carcasses were recovered in one tributary, Taylor Creek. Tributary chinook are sampled for age class and point of origin, whether they are of wild stock or hatchery fish marked by the State's WDFW or the University of Washington.

Surveys conducted during the fall of 2002 in the Cedar River tributaries have been the most extensive cooperative effort by WDFW and King County WLRD staff to date. Survey work in 2002 showed that chinook salmon had limited access to tributary habitats from the mainstem Cedar River.

To better understand distribution and timing of chinook use of tributary habitats, future research may be designed to (1) determine the relationship between total abundance of chinook salmon entering the system and incidence of tributary spawning; (2) determine the influence of flow from both the mainstem and tributaries on spawning distribution and timing; (3) determine the extent of species competition, including hatchery strays; (4) chinook productivity in tributaries of the Cedar River; and (5) age structure of chinook spawners in tributaries. Future surveys will help establish trends for escapement, run timing, distribution, age structure, and spawning for chinook salmon.

ACKNOWLEDGEMENTS

We appreciate the continued funding provided by the King Conservation District to carry out this work. In addition, a number of individuals from WDFW and WLRD were instrumental in completing the Cedar River chinook tributary surveys in 2002, and appreciate their efforts in the field.

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PHOTOS

Taylor Creek

Peterson Creek

Rock Creek

Walsh Lake Creek